

# Android 101

Jim Kolotouros

Prepared by Android Global Business team [REDACTED], Christopher Li, Sidney Lee)  
May 2019

Google

Confidential + Proprietary

**EXHIBIT 647.R**

EXHIBIT 647.R-001

CONFIDENTIAL

GOOG-PLAY-000128863.R

# Agenda

What is Android?

---

Why did we build it?

---

Where are we now?

---

Challenges and opportunities on the horizon

Google

Confidential + Proprietary

EXHIBIT 647.R-002

CONFIDENTIAL

GOOG-PLAY-000128864.R

# The Basics

What is Android? Overview of  
Android, Google Mobile Services  
(GMS), Compatibility, and  
Fragmentation

Google

Confidential + Proprietary

EXHIBIT 647.R-003

CONFIDENTIAL

GOOG-PLAY-000128865.R

# Google Search and Services in early 2000s....

A SINGLE SERVICE ON A SINGLE WEBPAGE ON A SINGLE BROWSER ON A SINGLE OS



## Evolution of a desktop strategy:

- We had access via Windows (IE) and then Mac (OS X/Safari) but always worried about getting blocked by 3rd party OS/browser platforms
- Netscape Navigator = Google's first search distribution deal. Firefox and Safari search deals came later
- Google Toolbar & Protector provided access to IE users
- Initiated Chrome browser so that i) service & feature innovation, and ii) user access to search/services would not be throttled by IE
- ChromeOS eventually evolved from Chrome browser

Confidential + Proprietary

EXHIBIT 647.R-004

# A very new landscape in 2007

**Market Landscape:** iPhone launches in June 2007 which accelerates adoption of smart devices on multiple platforms



Nokia



Samsung



Apple



Motorola



LG



Sony

Google

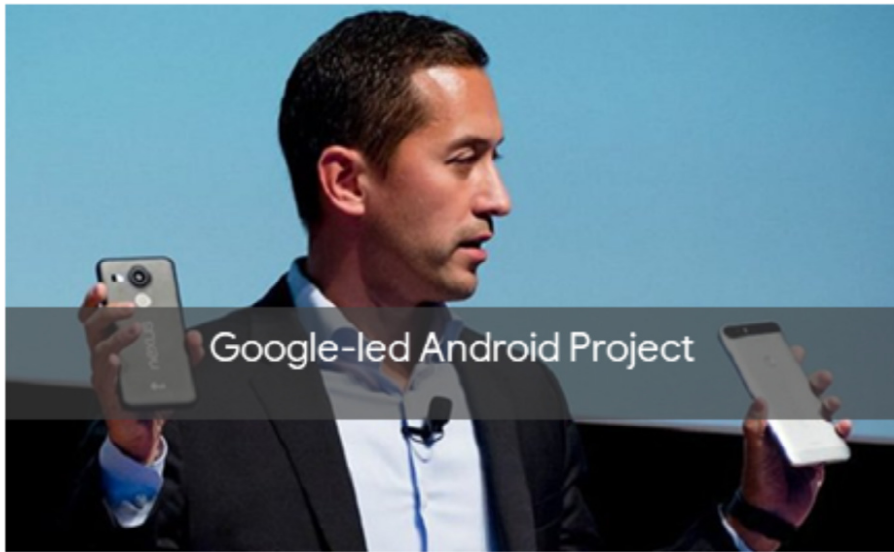
## IMPLICATIONS

- Same platform concerns as desktop; access and innovation
- Impossible to scalably get great experiences/apps in front of users - app team had to optimize each app for every single device / platform permutation ("fragmentation")
- What can Google do to focus its solutions/services innovations?
- What would make sense for Google as an App developer?

Confidential + Proprietary

EXHIBIT 647.R-005

# Android Open Source Project (AOSP) provided the solution to evolving market conditions for many...



Operator	Handset Makers	Software Companies	Commercialization Companies	Semiconductor Companies

Supported by consortium of partners

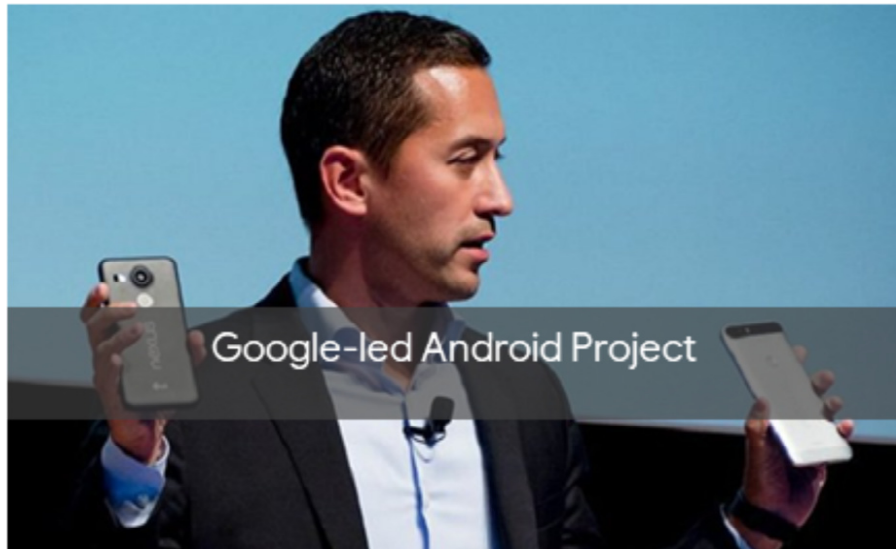
- **Created a solution to address platform and developer fragmentation:** Bought by Google in 2005
- **Ally with key ecosystem partners:** Created an alliance with a consortium of partners in 2007 to make an open source platform for ecosystem partners to participate and compete in the rapidly growing smartphone industry
- **Create friendly policies to encourage adoption by OEM's, developers, SOC's, etc.,:**

Google

Confidential + Proprietary

EXHIBIT 647.R-006

# Android Open Source Project (AOSP) provided the solution to evolving market conditions for many...



Google-led Android Project

Operator	Handset Makers	Software Companies	Commercialization Companies	Semiconductor Companies
SoftBank	htc	Ascender Corporation	Aplix	Audience
Do Co Mo	LG Electronics	Google	BORQS	intel
Sprint	MOTOROLA	myriad	noser	ARM
Telefonica	SAMSUNG	Living Image		QUALCOMM
vodafone	GARMIN	NUANCE		TI
TELECOM	acer	SONIVOX		ARM
China Unicom	ASUS	OMRON		
	TOSHIBA			

Supported by consortium of partners

Make it open  
source and  
free

- **Created a solution to address platform and developer fragmentation:** Bought by Google in 2006
- **Ally with key ecosystem partners:** Created an alliance with a consortium of partners in 2007 to make an open source platform for ecosystem partners to participate and compete in the rapidly growing smartphone industry
- **Create friendly policies to encourage adoption by OEM's, developers, SOC's, etc.,**

Google

Confidential + Proprietary

EXHIBIT 647.R-007

# What is AOSP?



- The Android Open Source Project (AOSP) consists of 3 key elements:
  - (1) An operating system,
  - (2) middleware, and
  - (3) open-source apps (e.g., dialer, email, gallery, and messaging services).
- Manufacturers, carriers, and third-party developers can use these components as-is or can customize them into their own proprietary versions without a license from Google.
- Amazon is one example of a company which uses AOSP to built out their own proprietary version (FireOS)

Google

Confidential + Proprietary

EXHIBIT 647.R-008

CONFIDENTIAL

GOOG-PLAY-000128870.R

## What is compatibility? Why & where does it matter?

Device compatibility is important to ensure that developers have confidence that their app will work perfectly on a specific form factor; it allows developers to focus their creativity and innovation while accessing a maximum universe of devices & users

## Compatibility stretches across different form factors as well

The Android platform works across several device form factors - **mobile devices (smart phones, tablets), wearables, TVs, and auto**; therefore, the Android compatibility requirements apply to these device types as well



**Note:** Wear, Auto, Audio, and TV are unique in that GMS-equivalents for wearables and TV's requires more than just a MADA (more on this later)

Google

Confidential + Proprietary

EXHIBIT 647.R-010

CONFIDENTIAL

GOOG-PLAY-000128872.R

## Google Mobile Services (GMS) layered on top of AOSP



- The Android Open Source Project (AOSP) consists of 3 key elements:
  - (1) An operating system,
  - (2) middleware, and
  - (3) open-source apps (e.g., dialer, email, and messaging services).
- Manufacturers, carriers, and third-party developers can use these components as-is or can customize them into their own proprietary versions without a license from Google.
- Google Mobile Services (GMS) apps, in contrast, are Google's proprietary apps

Google

Confidential + Proprietary

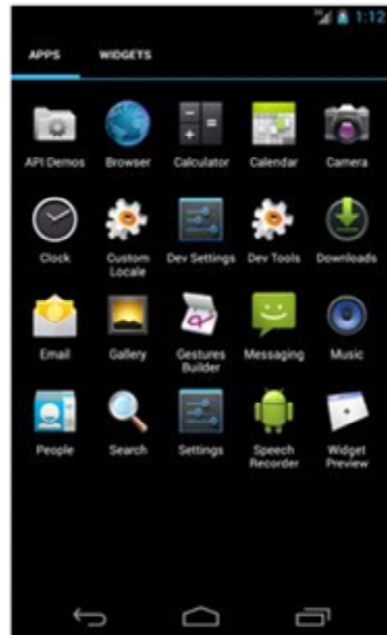
EXHIBIT 647.R-011

CONFIDENTIAL

GOOG-PLAY-000128873.R

# AOSP and Google Mobile Services (GMS) are often inaccurately intermixed and misunderstood

## PURE AOSP



## AOSP + GMS pre-loaded onto device



Google

OEMs can choose to load Google Mobile Service (GMS) on any (or none) of their devices to provide a more comprehensive out-of-box experience.

This point is not always well understood.

GOOGLE IN EUROPE

Android has created more choice, not less



Sundar Pichai  
CEO

Published on 9/16/2016

If you buy an Android phone, you're choosing one of the world's two most popular mobile platforms—one that has expanded the choice of phones available around the world.

Today, the European Commission issued a competition decision against Android, and its business model. The decision ignores the fact that Android phones compete with iOS phones, something that 89 percent of respondents to the Commission's own market survey confirmed. It also misses just how much choice Android provides to thousands of phone makers and mobile network operators who build and sell Android devices to millions of app developers around the world who have built their businesses with Android, and billions of consumers who can now afford and use cutting edge Android smartphones.

Today, because of Android, there are more than 14,000 devices, at every price point, from more than 1,300 different brands, including Dutch, Finnish, French, German, Hungarian, Italian, Latvian, Polish, Romanian, Spanish and Swedish phone makers.

Android provides choice

Confidential + Proprietary

EXHIBIT 647.R-012

CONFIDENTIAL

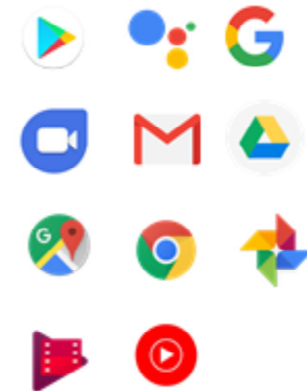
GOOG-PLAY-000128874.R

# We believed Google Applications would enhance the user experience on mobile phones and tablets

## What is GMS?

- **GMS is a collection of Google applications** for Android
  - Most GMS apps are optional and available a la carte
  - Some GMS apps are only available in a bundle; but there is no obligation for OEM's to pre-load these
- GMS works beautifully on *compatible* Android smartphones / tablets and is intended to provide the best possible mobile experience on smartphones (feature phones are in play again too!)
- App updates are administered by Google Play
  - E.g., Google Maps cannot be updated on a device if Play is also not installed
- **There is not a single agreement with any OEM that requires them to pre-load any GMS app on their device**

## GMS MANDATORY APPS



Google

Confidential + Proprietary

EXHIBIT 647.R-013

CONFIDENTIAL

GOOG-PLAY-000128875.R

# Google Play Services / GMS Core is an important element of Play

## What is Google Play Services / GMS Core?

- **Play Store provides a set of Google APIs** that help support functionality of **all** Android applications (aka GMS Core APIs, Google Play Services)
  - Ads
  - Maps
  - Analytics
  - Location, etc.,
- Used by GMS, and hundreds of thousands of 3rd party apps
- 826 out of the top 1000 Android apps use 1 or more GMS Core APIs (Facebook, WhatsApp, Twitter, and many other apps)

## GmsCore API Usage (3P)

- Only apps evaluated by Marmot (mostly limited to apps in active in Google Play Store)

### Nr Applications using GmsCore API

	Count
- All	636,142
gms.ads	414,506
gms.common	353,587
gms.maps	164,252
gms.gcm	140,041
gms.analytics	97,374
gms.location	90,457
gms.plus	74,466
gms.games	52,085
gms.auth	39,121
gms.appstate	21,439
gms.internal	16,634
gms.b	8,449
gms.a	6,472
gms.wallet	4,537
gms.drive	4,263
gms.cast	3,953
gms.wearable	3,820

Google

Confidential + Proprietary

EXHIBIT 647.R-014

CONFIDENTIAL

GOOG-PLAY-000128876.R

# GMS requires signing a set of agreements with Google - ACC and MADA are the two main ones

## Android Compatibility Commitment (ACC)

## Mobile Application Distribution Agreement (MADA)

What does Google get



**Compatibility:** Company will **only distribute Android devices that are Android-Compatible Devices**. i.e., if a device uses Android (even without GMS), it must be compatible (pass the compatibility test suite; comply with CDD). Exceptions are granted on a case-by-case basis



**Pre-load + Placement:** Pre-load i) GMS mandatory apps, and ii) search widget, Play store, and Google Collection on the default home screen (i.e., invoked by the home button)

but...

Companies do not need to sign any other agreements, such as MADA, although almost all OEMs take this step. Carriers and retailers do not/cannot sign the ACC

**MADA gives OEMs a device-by-device choice.** OEM can pre-load any other application in addition to Google services; there's no obligation for an OEM to load GMS on any device. **Zero exclusivity within the MADA**

Google

Confidential + Proprietary

EXHIBIT 647.R-015

CONFIDENTIAL

GOOG-PLAY-000128877.R

## Common misconceptions with Android & GMS

STATEMENT	TRUE	FALSE	REALITY
If a partner signs up for a GMS license, all their devices must include GMS	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Partner can choose whether or not to pre-load GMS onto their devices on a <b>device-by-device</b> basis
An Android device that does not have GMS pre-installed is a fork of Android	<input type="checkbox"/>	<input checked="" type="checkbox"/>	A device is defined as a fork of Android if the underlying ROM (software image) is not Android-compatible
Google requires some app exclusivity as part of the GMS licensing process	<input type="checkbox"/>	<input checked="" type="checkbox"/>	There are no exclusivity provisions as part of the MADA agreement. However, we do offer to select partners a revenue share opportunity in exchange for some exclusivity clauses. The revenue share agreement is <b>separate from</b> GMS licensing.

Google

Confidential + Proprietary

EXHIBIT 647.R-016

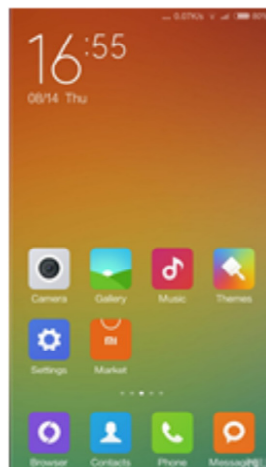
CONFIDENTIAL

GOOG-PLAY-000128878.R

## So what is actually a forked device?

“ABI Research reports that forked Android or AOSP smartphones grew 20% sequentially from 1Q 2014 to 2Q 2014 (total market growth was 3% sequentially) and also accounted for **20% of the smartphone market.**”

-ABI Research



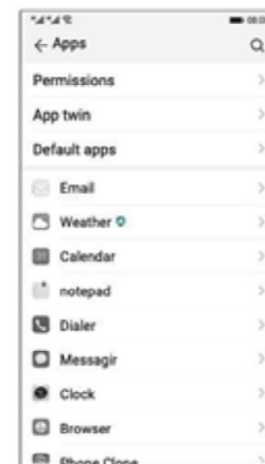
Xiaomi  
MIUI



OnePlus  
Oxygen OS



Amazon  
Fire OS



Huawei  
HongMeng OS

Google

Confidential + Proprietary

EXHIBIT 647.R-017

CONFIDENTIAL

GOOG-PLAY-000128879.R

## So what is actually a forked device?

“ABI Research reports that forked Android or AOSP smartphones grew 20% sequentially from 1Q 2014 to 2Q 2014 (total market growth was 3% sequentially) and also accounted for **20% of the smartphone market.**”

-ABI Research



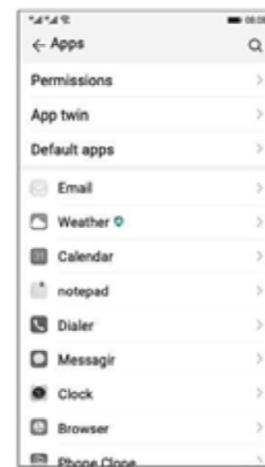
Xiaomi  
MIUI



OnePlus  
Oxygen OS



Amazon  
Fire OS



Huawei  
HongMeng OS

Google

Confidential + Proprietary

EXHIBIT 647.R-018

CONFIDENTIAL

GOOG-PLAY-000128880.R

## Huawei Case Study - what will they be able to do / not do?



Google

Confidential + Proprietary

EXHIBIT 647.R-019

CONFIDENTIAL

GOOG-PLAY-000128881.R

# Benefits of Android

- Why did we build the platform?
- What's the macro relationship to Google?

Google

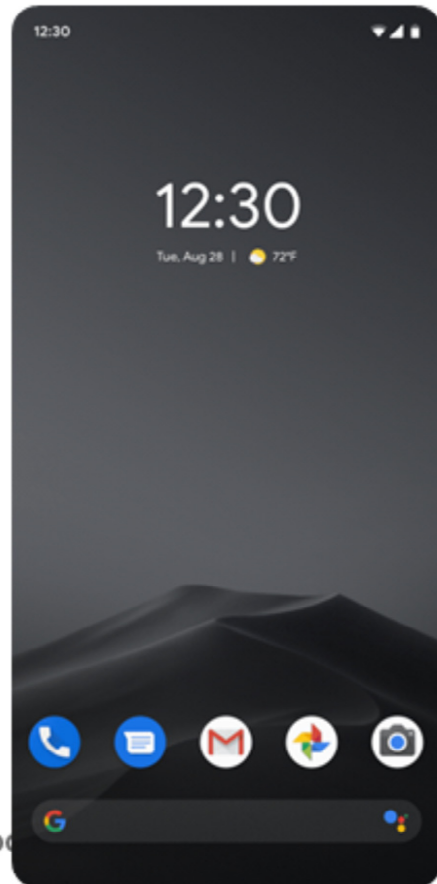
Confidential + Proprietary

EXHIBIT 647.R-020

CONFIDENTIAL

GOOG-PLAY-000128882.R

# Android was built to help secure more users for Google services...



## Tools and programs to make Google internet services successful

### Preload

- MADA
- GMS Req
- RSA
- Programs: GMS Express, A-Go
- Bespoke: Ex: "N50M", "Waterloo", "Optimus"

### Default Intent

- RSA
- Program
- Bespoke

### Placement (Hotseat, DHS)

- RSA
- Program
- Bespoke

### First three + exclusivity

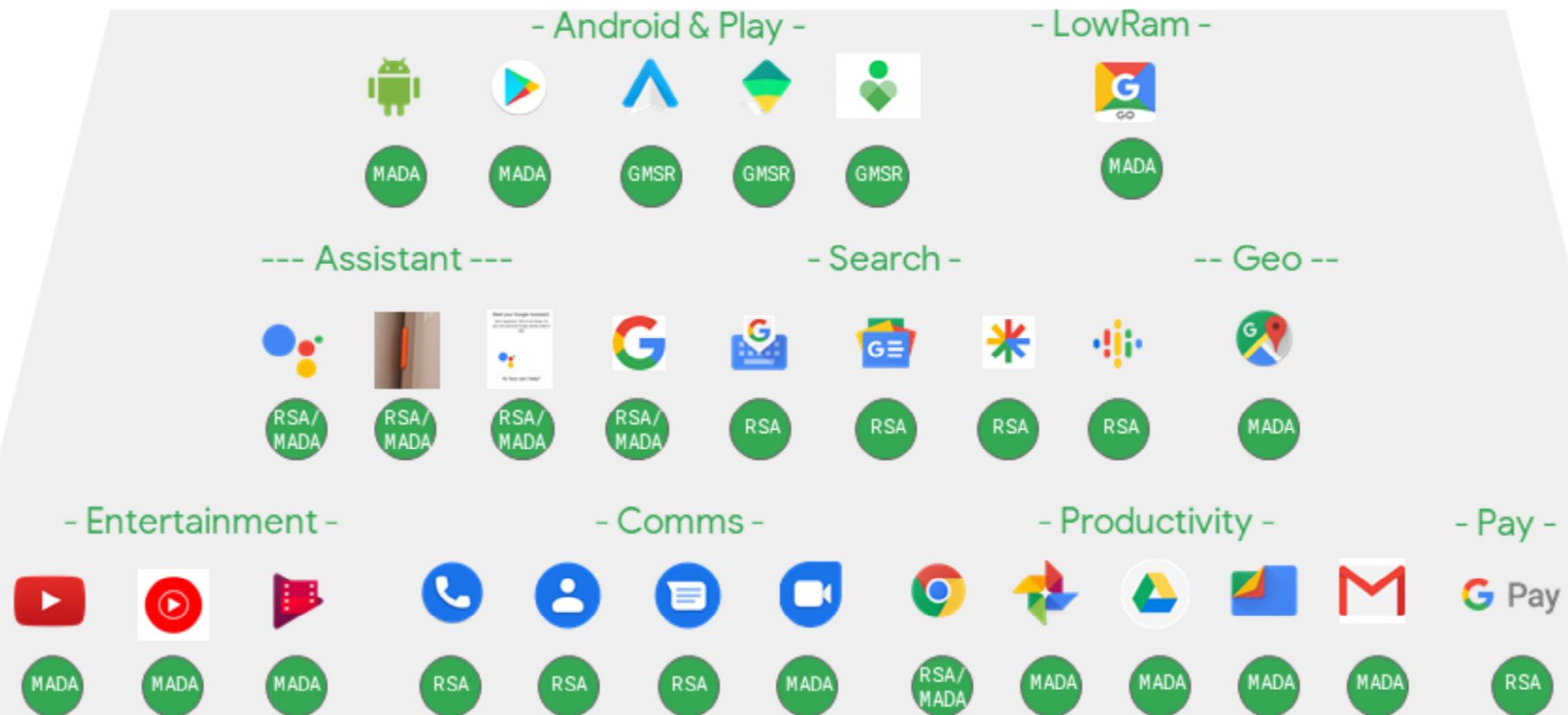
- RSA
- Program
- Bespoke

As baseline, apply MADA / GMS to 1B new device activations per year, and RSA / Programs / Bespoke to large subset of new activations

Confidential + Proprietary

EXHIBIT 647.R-021

# Android was built to help secure more users for Google services...



Android also owns the APIs, definitions, and requirements for which the ecosystem (apps, devices) must abide by

Google

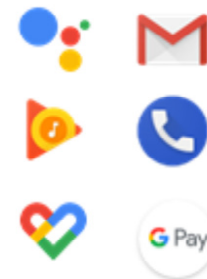
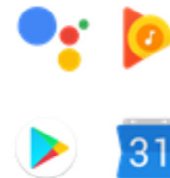
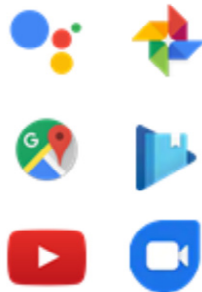
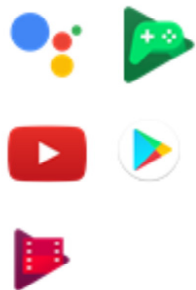
Confidential + Proprietary

EXHIBIT 647.R-022

CONFIDENTIAL

GOOG-PLAY-000128884.R

... across all device verticals



Note: only a sampling; not comprehensive

Google

Confidential + Proprietary

EXHIBIT 647.R-023

CONFIDENTIAL

GOOG-PLAY-000128885.R

## Case study: Assistant - quick ramp to 1B scale with increasing presence

Instant distribution  
Long-press home & AGSA



Premium entry points  
Dedicated H/W button



Increased presence  
Built into OS, suggestion chips, ambient mode



Google

Confidential + Proprietary

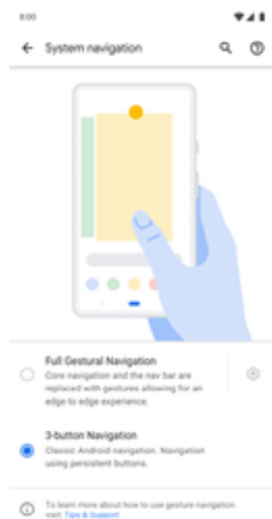
EXHIBIT 647.R-024

CONFIDENTIAL

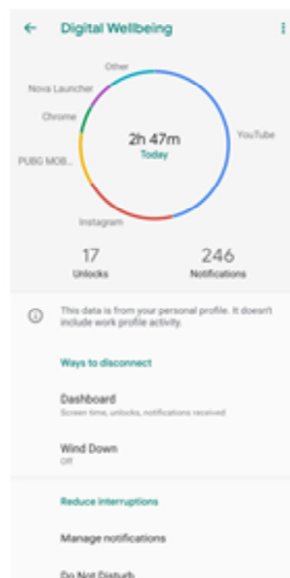
GOOG-PLAY-000128886.R

# We also provide the guardrails for the platform (GMS Requirements)

One gesture please...



Digital well-being for users and control for parents



Safe driving



Fresh device software



Device preload safety



Google

Confidential + Proprietary

EXHIBIT 647.R-025

CONFIDENTIAL

GOOG-PLAY-000128887.R

## Ensuring our experiences are not throttled, even in unique circumstances

"Lenovo Smart Tab Powered by Amazon Alexa"  
2-in-1 experience... dagagadg



Google

Confidential + Proprietary

EXHIBIT 647.R-026

CONFIDENTIAL

GOOG-PLAY-000128888.R

# Android Today

- Current lay of the land
- Key trends
- Where are things headed

Google

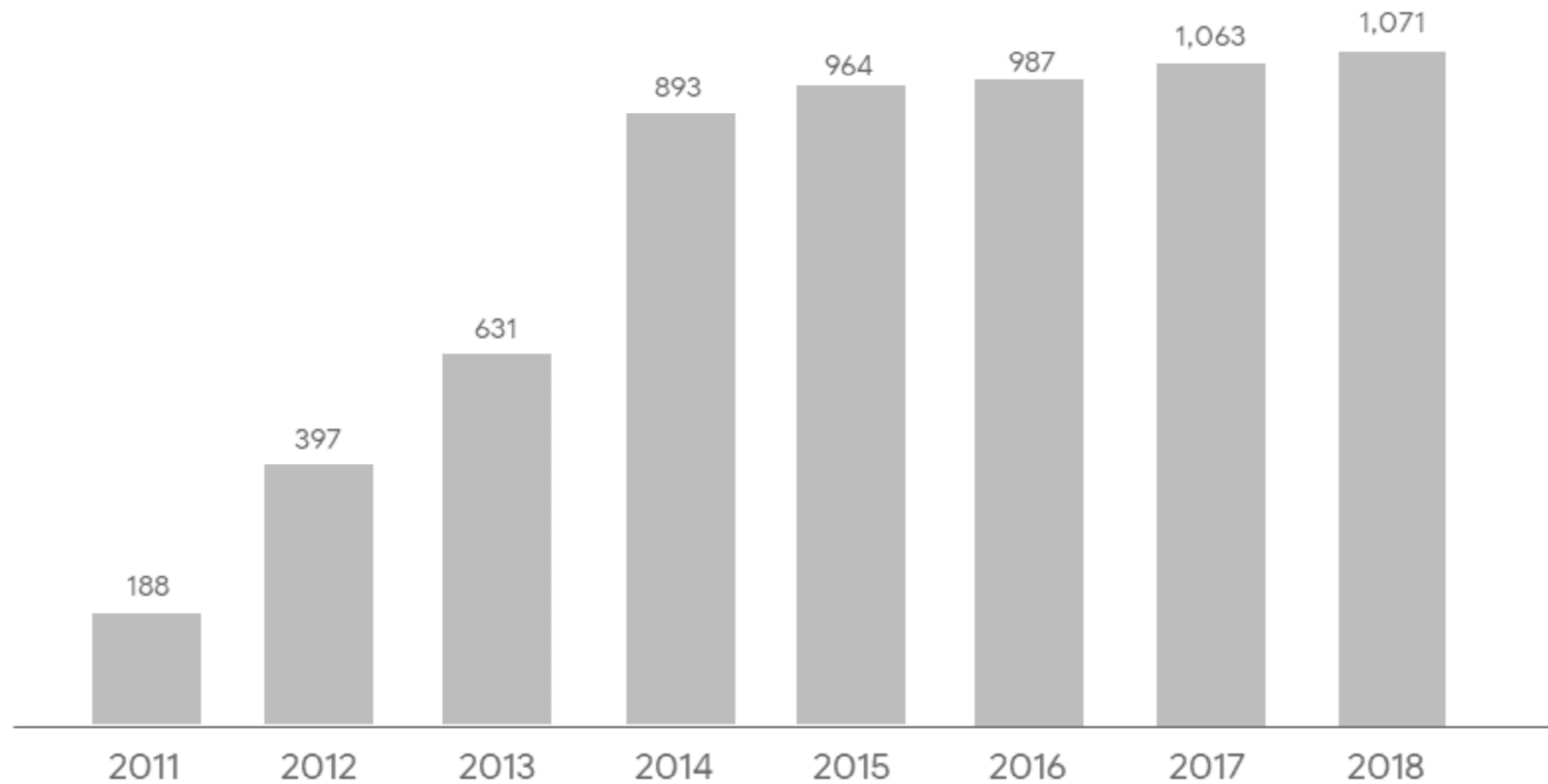
Confidential + Proprietary

EXHIBIT 647.R-027

CONFIDENTIAL

GOOG-PLAY-000128889.R

## Mobile remains the largest vertical, but growth is slowing (GMS Activations)



Google

Confidential + Proprietary

EXHIBIT 647.R-028

CONFIDENTIAL

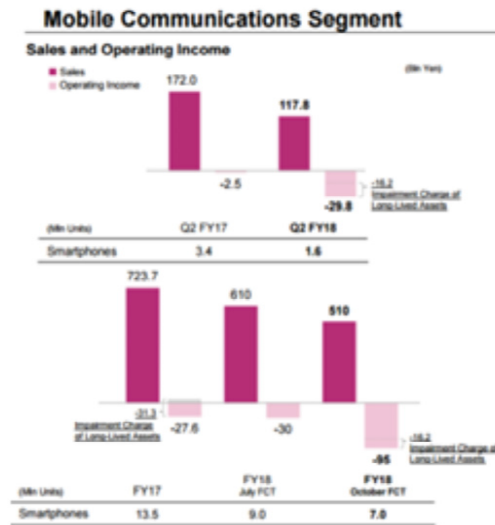
GOOG-PLAY-000128890.R

# Profitability story remains challenging... may get worse over time

LG Mobile Financials



Sony Mobile Financials



## Lenovo makes first mobile profit since Motorola buy

LinkedIn Twitter Facebook More

21 FEB 2019  
AUTHOR

Joseph Marling  
Joseph Marling joined WorldView as the Asia Editor for its Asia Channel. Before joining the channel, Joseph was group editor for Taiwan Asia for more than ten years. In addition to writing features, news and blogs, he...

Read more

RELATED

Sony mobile woes continue

Apple limps ahead as iPhone revenue plummets

Flexible screen to power Razr revival

Tags: earnings, Lenovo

China-based Lenovo's Mobile Business Group posted a pre-tax profit in its fiscal Q3, the first since it acquired Motorola in 2014, despite a double-digit fall in revenue.

In the three months to end-December 2018, the division recorded a pre-tax profit of \$3 million compared with a \$124 million loss in the same period of 2017. Revenue dropped 19.6 per cent year-on-year to \$1.67 billion, which the company said was due to a move to focus on profitable growth in key markets.

Lenovo attributed the turnaround to "masterful execution" on a strategy to reduce expenses, streamline its product portfolio and focus on core markets.

North American volumes outgrew the market by a 40 points and China revenue quadrupled year-on-year, it said.

Google

Confidential + Proprietary

EXHIBIT 647.R-029

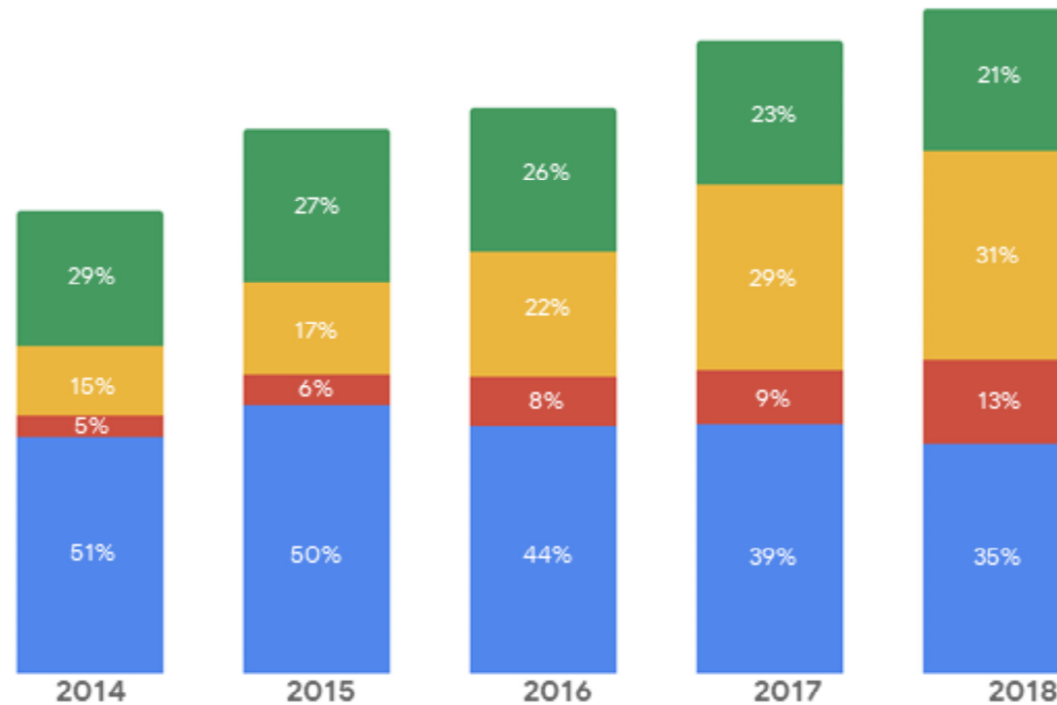
CONFIDENTIAL

GOOG-PLAY-000128891.R

# CN OEMs share of GMS activations growing; but changes are lurking...

■ CN OEMs ■ Huawei ■ Samsung ■ Everyone Else

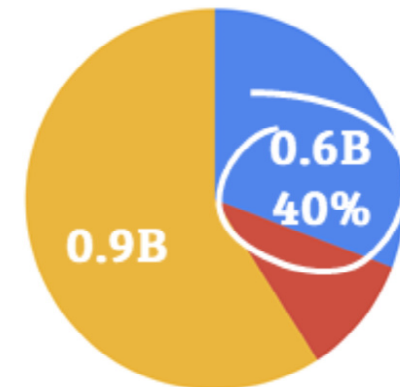
Total GMS Mobile Activations (2014-18)



CN & IN Volume Are Critical to Drive Economies of Scale & Component Access

2018 Global Smartphone Shipments

● China ● India ● RoW



**CN OEM SHARE GREW 2X TO 44%**

Google

Confidential + Proprietary

- Note: "CN OEMs" inc. Xiaomi, Oppo, Vivo, Gionee, TCL, ZTE, Lenovo/Moto, Transsion, OnePlus, Coolpad, Wiko, and Meizu

EXHIBIT 647.R-030

CONFIDENTIAL

GOOG-PLAY-000128892.R

## CN OEMs Will Continue to Seek Out New Sources of Growth Outside CN

Developing APAC & MEA will serve as new sources of growth. Increased OEM competition in these markets should benefit consumers and have significant secondary effects e.g. helping drive local economies & assembly capabilities, injecting vibrancy into the ecosystem etc. Geopolitical forces will play a major role, potentially resulting in ABC (anywhere but China) supply chain shifts.

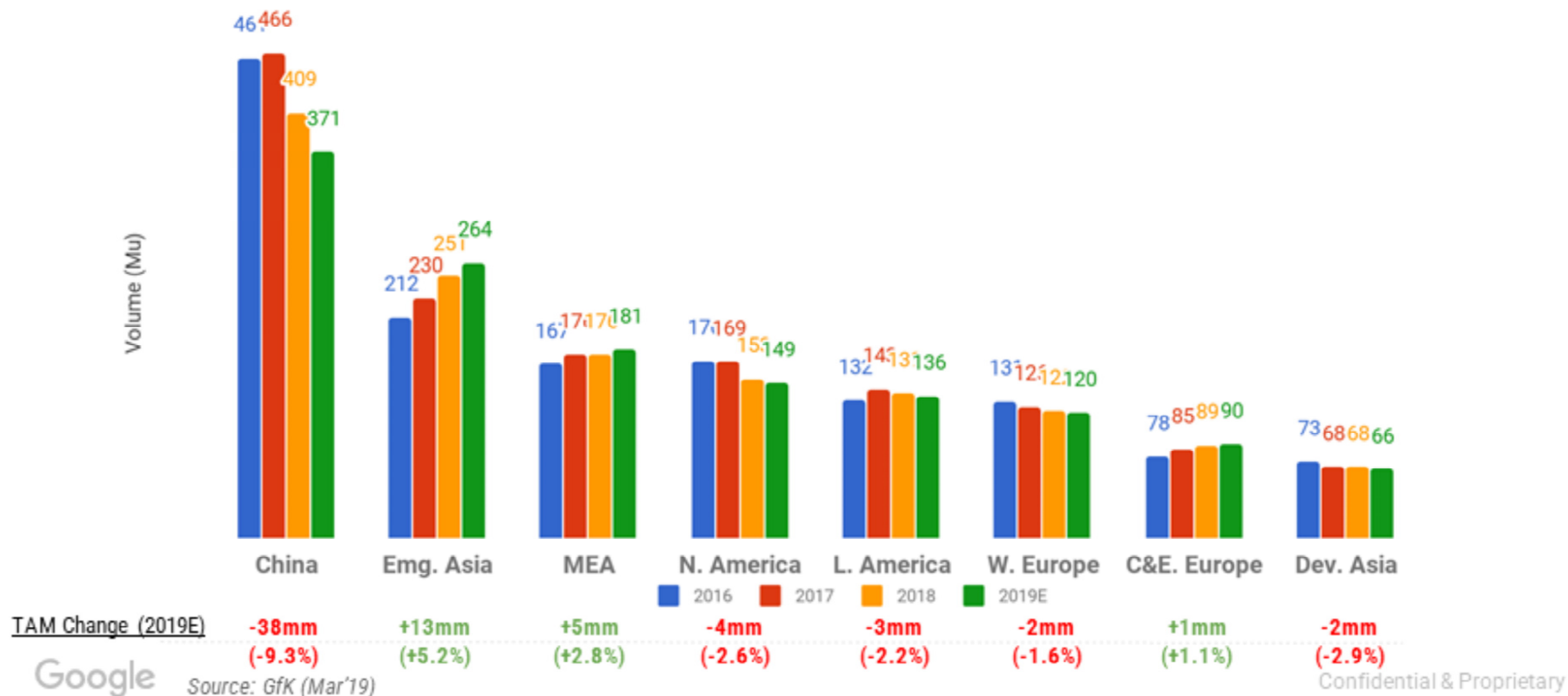
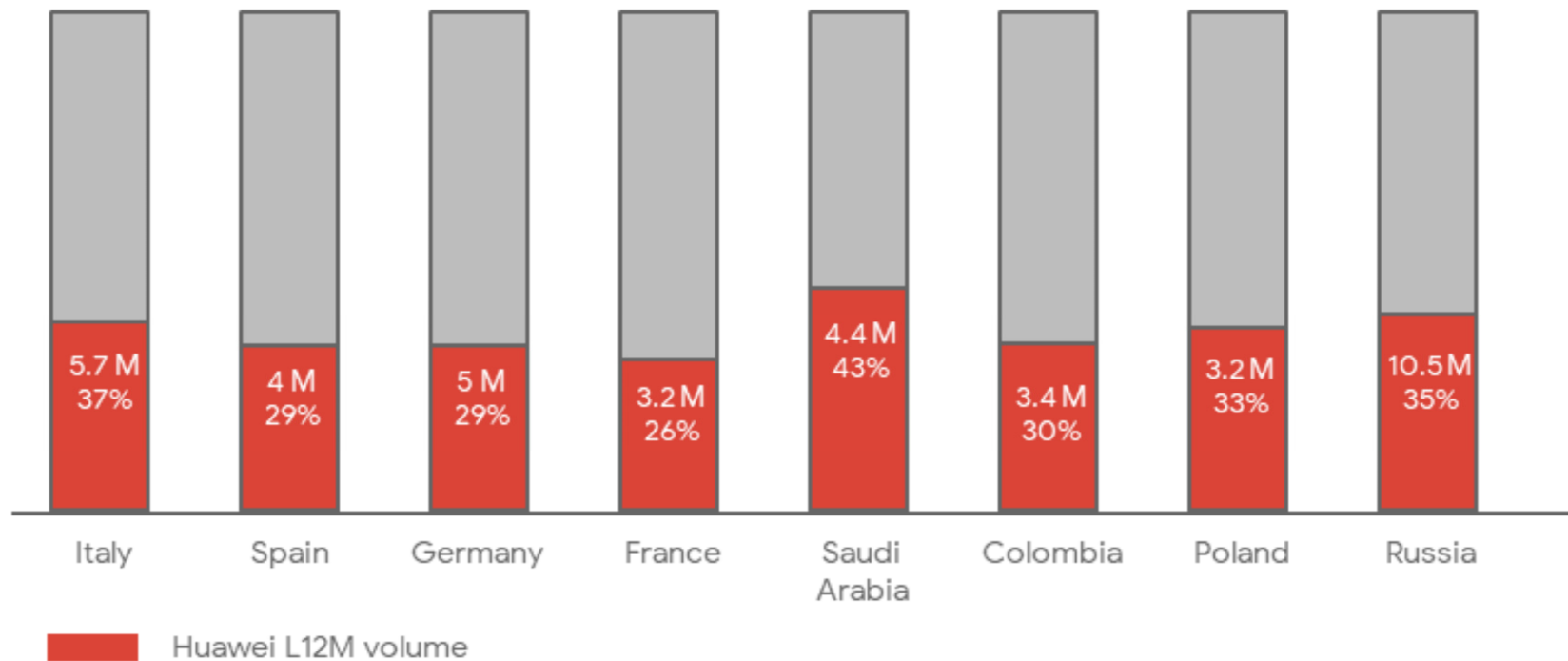


EXHIBIT 647.R-031

... but the latest news changes things



Google

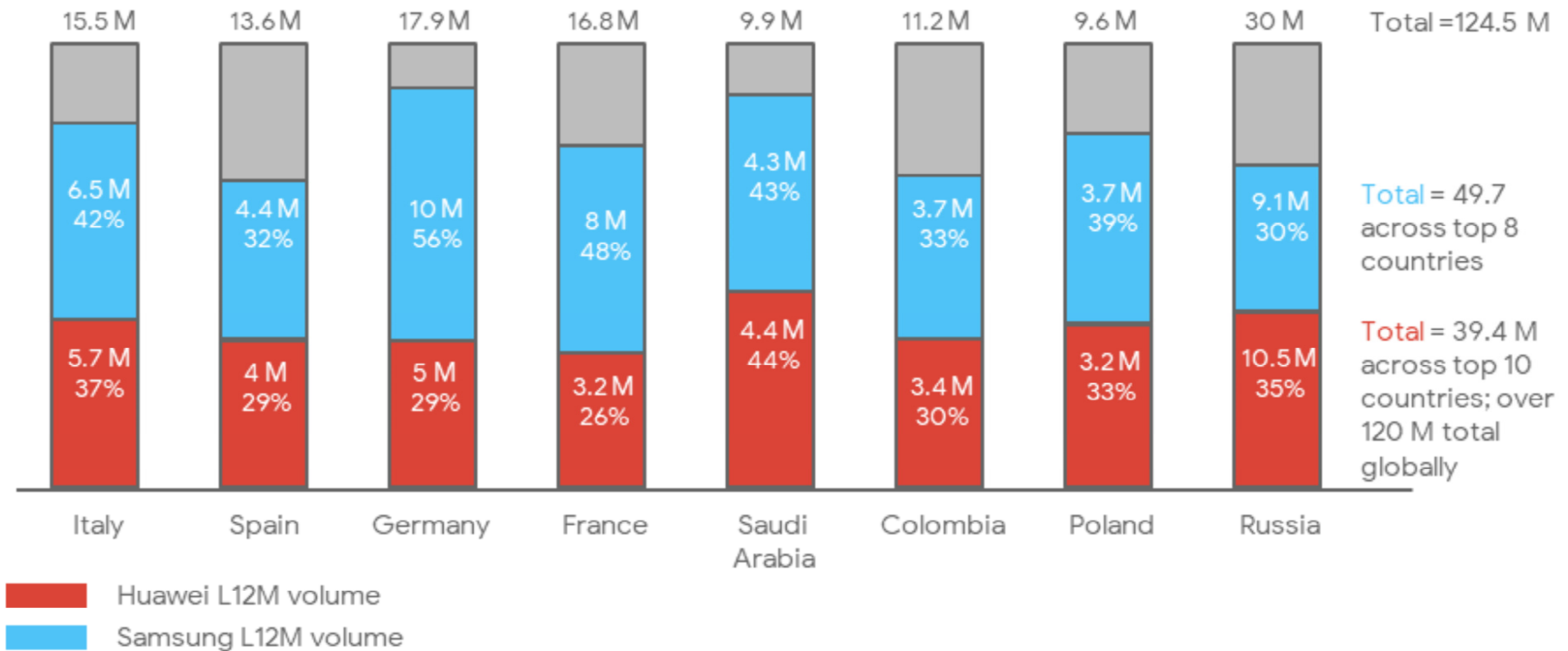
Confidential + Proprietary

EXHIBIT 647.R-032

CONFIDENTIAL

GOOG-PLAY-000128894.R

## Android share in select markets - OEM Portfolio balance a concern



Google

Confidential + Proprietary

EXHIBIT 647.R-033

CONFIDENTIAL

GOOG-PLAY-000128895.R

# Challenges on the horizon

- Regulatory (EEA, China)
- Balanced set of partners
- Keeping partners healthy
- Switching
- Alternate 3P platforms
- Execution

Google

Confidential + Proprietary

EXHIBIT 647.R-034

CONFIDENTIAL

GOOG-PLAY-000128896.R

# Regulatory



Google

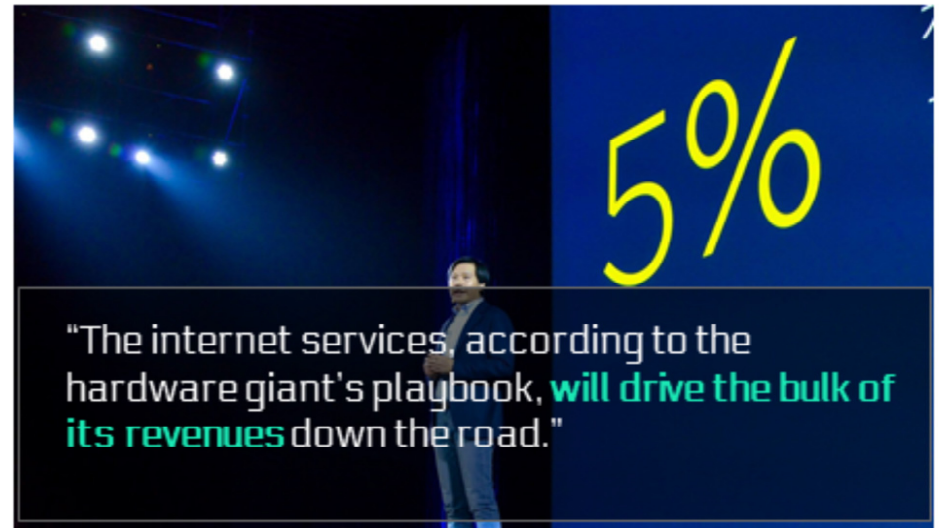
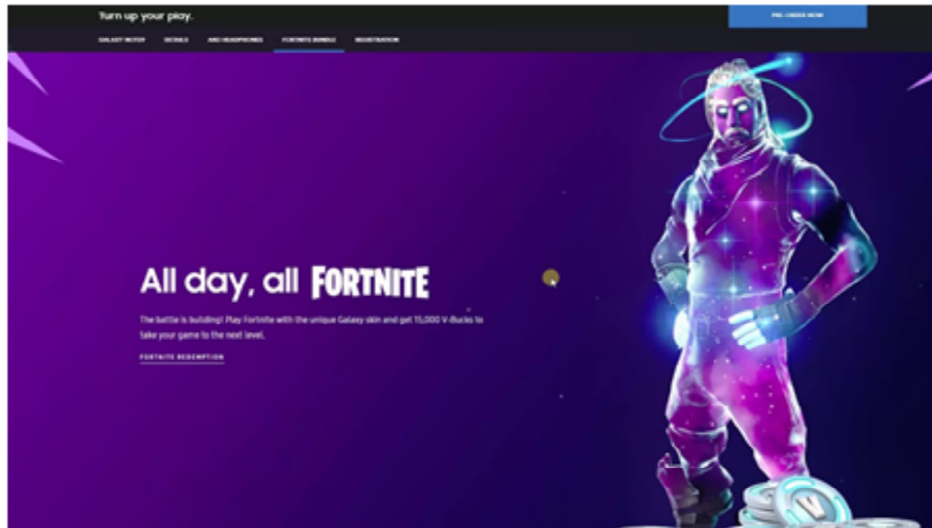
Confidential + Proprietary

EXHIBIT 647.R-035

CONFIDENTIAL

GOOG-PLAY-000128897.R

## Keeping partners healthy, including financially



Google

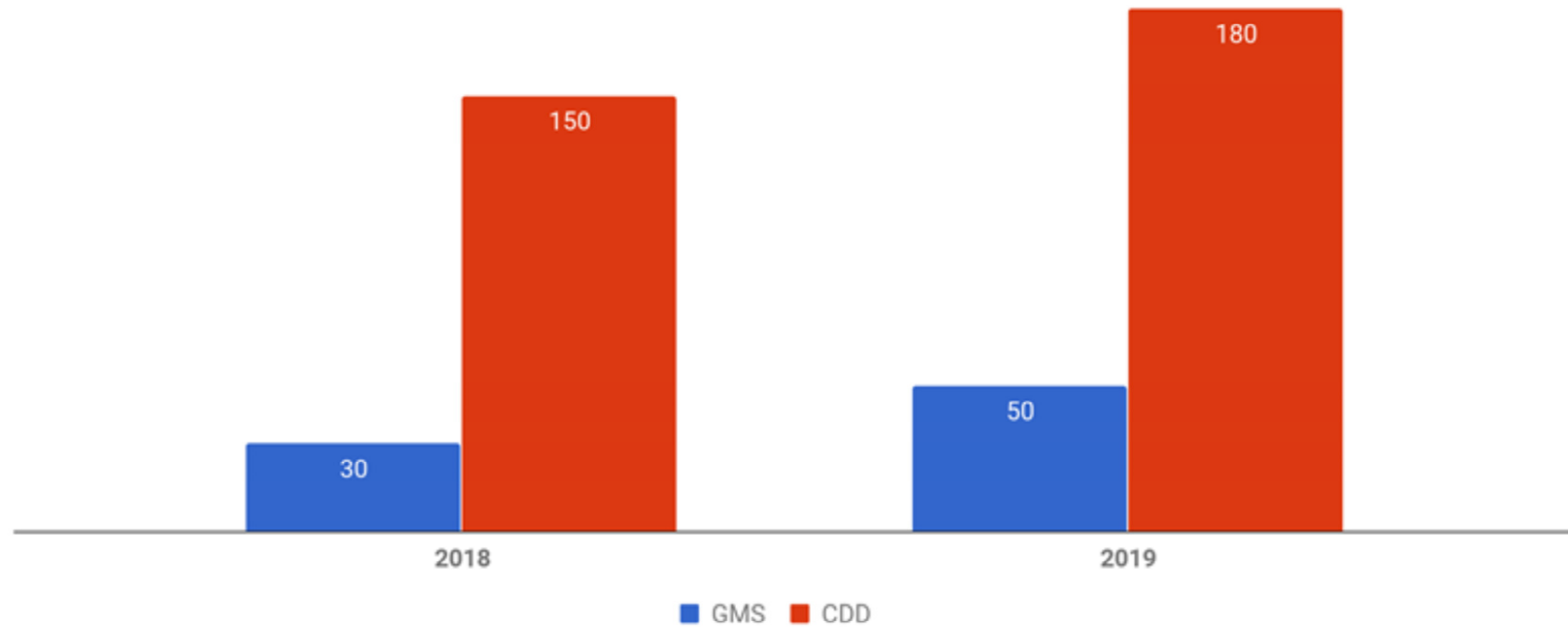
Confidential + Proprietary

EXHIBIT 647.R-036

CONFIDENTIAL

GOOG-PLAY-000128898.R

## Asking our partners to do more and more...



*Note: Approximate number of requirements. Also note that increase is not always increasing across multiple years*

Google

Confidential + Proprietary

EXHIBIT 647.R-037

CONFIDENTIAL

GOOG-PLAY-000128899.R

# APPENDIX

Google

Confidential + Proprietary

EXHIBIT 647.R-038

CONFIDENTIAL

GOOG-PLAY-000128900.R

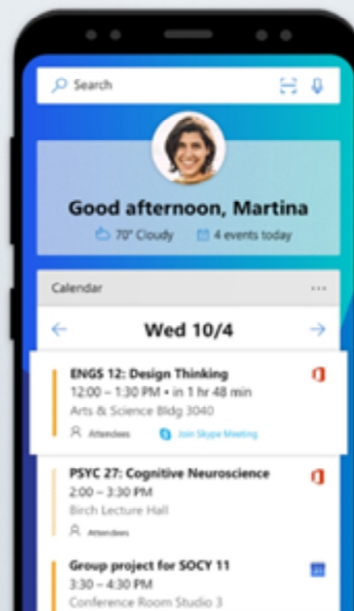
## Ambitious 3P Platforms



Google

### See what's important to you at a glance

Customize your feed to see the news, events, docs, and contacts you want to see, and remove the stuff you don't.



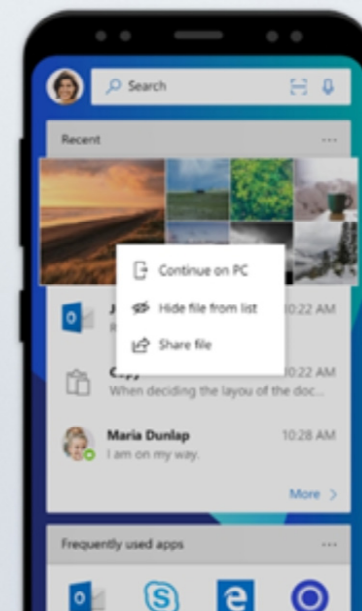
### There's no place like Home screen

Customize your Android home screen with Microsoft Launcher custom set of wallpapers.



### Take a photo on your phone, open it on your PC

Microsoft Launcher links your Android device and PC so you can open photos or docs on a bigger screen, instantly.



Confidential + Proprietary

EXHIBIT 647.R-039

CONFIDENTIAL

GOOG-PLAY-000128901.R

Execution - increasingly complex and difficult to align internally, but an opportunity as well



Google

Confidential + Proprietary

EXHIBIT 647.R-040

CONFIDENTIAL

GOOG-PLAY-000128902.R

## Strong growth in all Android verticals



2X M  
activations / 12M



1 M  
activations / 12M



XX M  
activations / 12M



XX M  
activations / 12M

Google

Confidential + Proprietary

EXHIBIT 647.R-041

CONFIDENTIAL

GOOG-PLAY-000128903.R

**Slide 41**

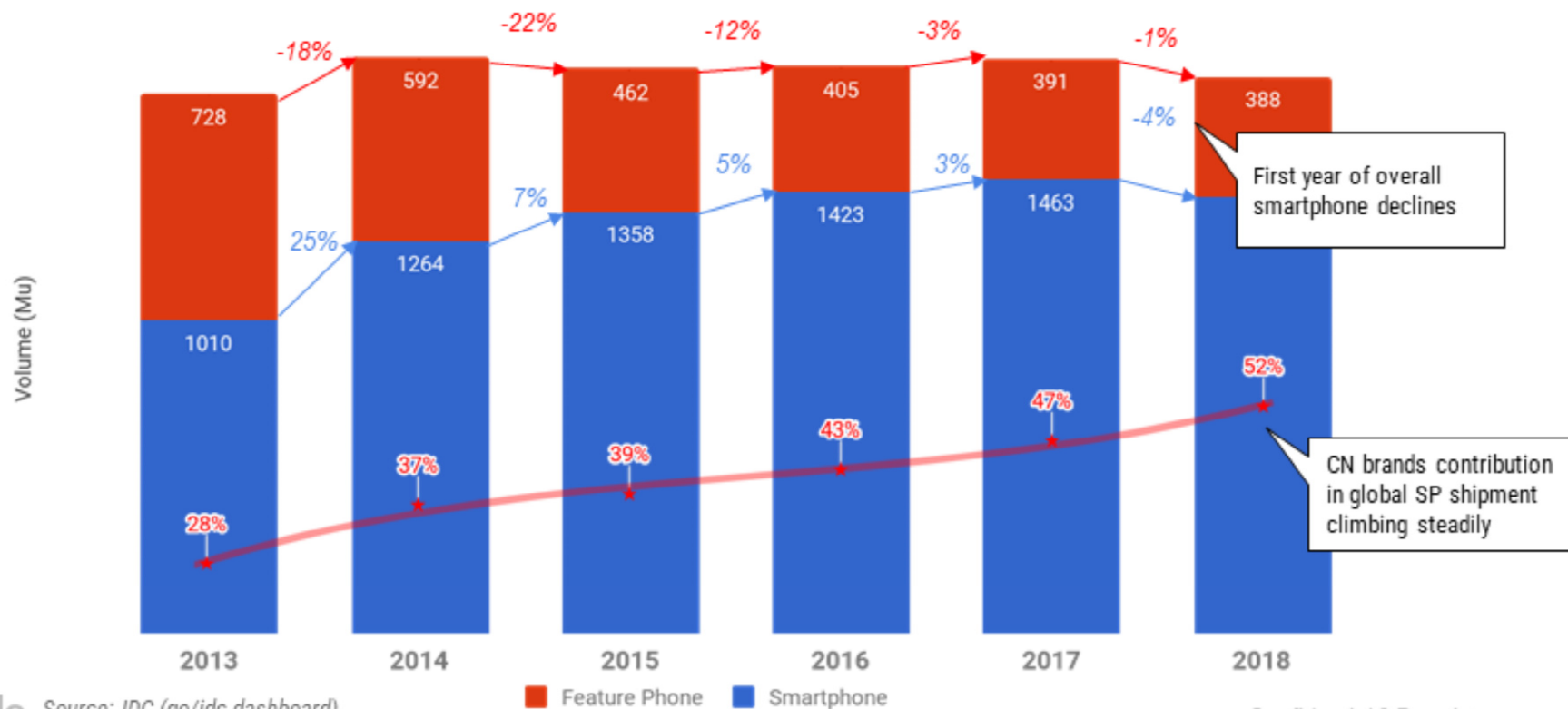
---

- 2** Jim to fill out  
Christopher Li, 6/19/2019
- 1** Jim to fill out  
Christopher Li, 6/19/2019

EXHIBIT 647.R-042

## SP & FP Markets Decline in 2018 with CN OEMs Share Rising

We are at single digit shipment growth overall. FP conversion is occurring, albeit slowly. Globally, top-6 OEMs to account for >65% market share and CN OEMs are expected to account for more than half of global SP shipment in '18. (TBD)



Google

Source: IDC (go/idc-dashboard)

Note: All figures inc. Apple unless otherwise stated

Confidential & Proprietary

EXHIBIT 647.R-043

CONFIDENTIAL

GOOG-PLAY-000128905.R

# Android Compatibility Requirements



1) Comply 100% with the requirements of the Compatibility Definition Document (“[CDD](#)”)

2) Pass 100% of the Compatibility Test Suite (“[CTS](#)”)

CTS is composed of 1000s of automated test cases to ensure compatibility with platform

**Note:** 1) Google updates CDD and CTS for each version of Android and releases them as part of AOSP. 2) Also, we do have a liberal exception/exemption policy to grandfather in older devices and/or address unique form factors

Google

Confidential + Proprietary

EXHIBIT 647.R-044

CONFIDENTIAL

GOOG-PLAY-000128906.R

## Review of hypothetical scenarios

SCENARIO	YES	NO	NOTES
Can a mobile phone without Google Play and GMS core APIs run other Android apps?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Yes, as long as the apps don't require any APIs from GMS Core or they find ways to replicate API functionality (themselves or other 3P APIs)
Can someone effectively utilize GMS Core APIs without Google Play installed?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No, the APIs require and use Play's infrastructure
If a device has Google Play illegally sideloaded, can it access GMS Core APIs?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can access GMS Core APIs, but we cannot validate the authenticity of the Core API functionality. This is why enforcing unlicensed devices is important.
Does Apple offer its own version of iOS "GMS Core APIs"?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	iOS has a similar API model, but there are less APIs and they do not offer as deep functionality

Google

Confidential + Proprietary

EXHIBIT 647.R-045

# Many media-defined Android forks are in fact not forks and are compatible



Xiaomi  
MIUI

**NOT a FORK  
- COMPATIBLE -**



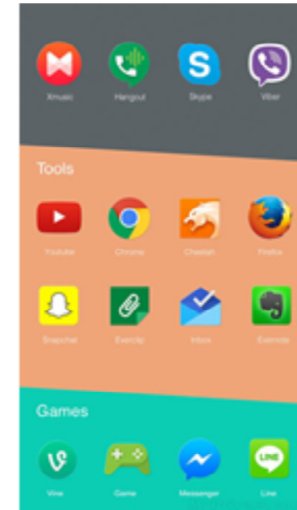
BLU  
Cyanogen 12

**NOT a FORK  
- COMPATIBLE -**



Amazon  
Fire OS

**ANDROID FORK  
-  
INCOMPATIBLE**



OnePlus  
Oxygen OS

**NOT a FORK  
- COMPATIBLE -**

Google

Confidential + Proprietary

EXHIBIT 647.R-046

CONFIDENTIAL

GOOG-PLAY-000128908.R